



# EMERGENCY MEDICAL SERVICES for CHILDREN

Committee on Pediatric Emergency Medical Services

Jane S. Dorsch and Kathleen N. Lohr, *Editors*

Division of Health Care Services  
INSTITUTE OF MEDICINE

NATIONAL ACADEMY PRESS  
Washington, D.C. 1993

162.17  
L73  
**NATIONAL ACADEMY PRESS • 2101 Constitution Avenue, N.W. • Washington, D.C. 20418**

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competence and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

The Institute of Medicine was chartered in 1970 by the National Academy of Sciences to engage distinguished members of the appropriate professions in the examination of policy matters pertaining to the health of the public. In this, the Institute acts under both the Academy's congressional charter responsibility to be an adviser to the federal government and its independent initiative in identifying issues of medical care, research, and education.

Support for this project was provided by the Maternal and Child Health Bureau of the Health Resources and Services Administration, U.S. Department of Health and Human Services, under Grant No. MCJ-117025-02. The views presented are those of the Institute of Medicine Committee on Pediatric Emergency Medical Services and are not necessarily those of the funding organization.

**Library of Congress Cataloging-in-Publication Data**

**Emergency medical services for children / Jane S. Dorsch and Kathleen N.**

**N. Lohr, editors**

p. cm.

**"Committee on Pediatric Emergency Medical Services, Division of Health Care Services, Institute of Medicine."**

Includes bibliographical references and index.

ISBN 0-309-04888-5

**t. Pediatric emergency services—United States—Planning.**

**I. Dorsch, Jane S. II. Lohr, Kathleen N., 1941- . III. Institute of Medicine (U.S.). Committee on Pediatric Emergency Medical Services.**

[DNLM: 1. Emergencies—in infancy & childhood. 2. Emergency Medical Services. WS 200 E5273 1993]

RJ370.E433 1993

362.1'8'083—dc20

DNLM/DLC

for Library of Congress

93-8084

CIP

W

Additional copies of this book are available from the National Academy Press, 2101 Constitution Avenue, N.W., Box 285, Washington, D.C. 20055. Call 800-624-6242 or 202-292-3313 (in the Washington Metropolitan Area).

Copyright 1993 by the National Academy of Sciences. All rights reserved.

Printed in the United States of America

The serpent has been a symbol of long life, healing, and knowledge among almost all cultures and religions since the beginning of recorded history. The image adopted as a logo type by the Institute of Medicine is based on a relief carving from ancient Greece, now held in the Staatliche Museen in Berlin.

## COMMITTEE ON PEDIATRIC EMERGENCY MEDICAL SERVICES

DONALD N. MEDEARIS, JR.,\* *Chair*, Charles Wilder Professor of Pediatrics, Harvard Medical School, and Chief, Children's Service, Massachusetts General Hospital, Boston, Massachusetts

RICHARD B. DONKER, Vice President, Clinical Services, Memorial Hospitals Association, Modesto, California

MARTIN R. EICHELBERGER, Professor of Surgery and Pediatrics, George Washington University School of Medicine, and Director of Emergency Trauma Services, Children's National Medical Center, Washington, D.C.

J. ALEX HALLER, JR., Professor of Pediatric Surgery, Pediatrics, and Emergency Medicine, Children's Medical and Surgical Center, The Johns Hopkins Hospital, Baltimore, Maryland

ROBERT L. HARMAN, Administrator, Grant Memorial Hospital, Petersburg, West Virginia

EDGAR B. JACKSON, JR.,\* Clinical Professor of Medicine, Case Western Reserve University School of Medicine, and Associate Chief of Staff, University Hospitals of Cleveland, Cleveland, Ohio

MARILYN A. KRUEGER, Commissioner, Second District, Saint Louis County, Duluth, Minnesota

JENNIFER LEANING, Medical Director, Health Centers Division, Harvard Community Health Plan, Inc., Brookline, Massachusetts

SUSAN D. McHENRY, Director, Emergency Medical Services, Office of Emergency Medical Services, Virginia Department of Health, Richmond, Virginia

PATRICIA A. MURRIN, Prehospital Coordinator, Division of Emergency Medical Services, Department of Health Services, County of San Diego, California

JAMES L. PATURAS, Director, Emergency Medical Services, Bridgeport Hospital, Bridgeport, Connecticut

BARRY G. RABE, Associate Professor of Health Politics, Department of Public Health Policy and Administration, School of Public Health, University of Michigan, Ann Arbor, Michigan

DONALD F. SCHWARZ, Assistant Professor of Pediatrics, Section on Adolescent Medicine, Department of Pediatrics, University of Pennsylvania, Philadelphia, Pennsylvania

JAMES S. SEIDEL, Professor of Pediatrics, UCLA School of Medicine, and Chief, General and Emergency Pediatrics, Harbor-UCLA Medical Center, Torrance, California

---

\*Institute of Medicine member

CALVIN C.J. SIA, Clinical Professor of Pediatrics, Department of Pediatrics, School of Medicine, University of Hawaii, Honolulu, Hawaii

RUTH E.K. STEIN, Professor and Vice Chairman, Department of Pediatrics, Albert Einstein College of Medicine, and Pediatrician-in-Chief, Bronx Municipal Hospital Center, Bronx, New York

GARY R. STRANGE, Associate Professor of Emergency Medicine, University of Illinois, College of Medicinc, Chicago, Illinois

J.J. TEPAS III, Professor of Surgery, Division of Pediatric Surgery, University of Florida College of Medicine, Department of Surgery, Jacksonville, Florida

JOSEPH A. WEINBERG, Associate Professor, Division of Critical Care, Department of Pediatrics, University of Tennessee, Memphis, and Director, Emergency Services, Le Bonheur Children's Medical Center, Memphis, Tennessee

*Study Staff*

JANE S. DURCH, Associate Study Director

KATHLEEN N. LOHR, Deputy Director, Division of Health Care Services and Study Director, beginning April 1992

MICHAEL L. MILLMAN, Study Director, through March 1992

DONNA D. THOMPSON, Administrative Assistant

KARL D. YORDY, Director, Division of Health Care Services

## Preface

The problem of childhood injuries and illnesses and the emergency care they require is immense and its consequences tragic. If the recent past is an indication of the immediate future, then more than 20,000 children under 19 years of age will die this year in the United States as a result of injury. An additional 30,000 will have a permanent disability as a result of brain injury. As disturbing as these data are, they are but the top of a huge pyramid; for each death of a child due to injury in this country, as many as 42 children are hospitalized and 1,120 children visit an emergency room. Moreover, emergency room visits by children as a result of injury are only one-third of the total number of visits by children to emergency rooms. The other two-thirds of those visits are due to illnesses, many of which are serious; these include debilitating asthma and life-threatening meningitis.

One cannot be aware of these data and not want to reduce their number and their impact. That goal can be achieved. The rates of death and disability in the United States exceed the comparable rates in Canada, France, the former Federal Republic of Germany, and Great Britain. If this country would energetically pursue preventive health measures, including the establishment of continuous, family-oriented, community-based primary care for all children, there is no reasonable doubt but that the number of injuries and episodes of illness—and their consequences—could be significantly reduced. Moreover, if that were accomplished, the savings would be enormous in economic as well as humanitarian terms.

The charge to this Institute of Medicine committee, however, was not to design the ideal medical home (primary care) for children, nor was it to develop strategies for the development and implementation of effective injury prevention measures. It was to review the nature and extent of pediatric emergencies and the emergency care available to children and to define

the characteristics of an emergency medical services system for children (EMS-C system), the elements of a data system needed for planning and evaluation, and the role of government in that system. In developing its response to this charge, the committee utilized fully the remarkable diversity in expertise and background of its multidisciplinary membership and prepared a report that is scholarly and detailed. It identified the essential components of an EMS-C system. It considered how best to ensure access to that EMS-C system. It recognized the very special needs of children in terms of anatomy, physiology, and psychology, and underscored how these must be met by EMS-C programs and personnel. Thus, there must be different and special equipment, different-sized instruments, different doses of different drugs, and different approaches to the psychological support and remedial care to be given to the ill or injured child. Guidelines by which personnel essential for the provision of emergency care for infants and children are to be trained, educated, and re-trained and re-educated must take into account these factors. Thus, the committee called attention to the importance of fully developing and organizing in a *system* all those special emergency services that children must have.

The committee believed that it was of critical importance to develop an initial uniform data set about these services in order to begin to obtain information that would be used to assess the system and its effectiveness. Mindful of the tragic toll of injury and illness emergencies, the committee further recognized the great importance of obtaining data needed for developing prevention strategies as well as for improving the EMS-C system as a whole.

The recommendations that reflect these matters are directed at all levels of government, many different health care professionals, and a wide range of voluntary groups. Some recommendations are directed to the whole of emergency medical services (EMS), for example, the need to develop an expanded 9-1-1 system nationally to provide access to EMS. Some are aimed at subtle modifications or minor (but significant) improvements in the existing system. Others require putting what now exists in some places into those places where no EMS now exists. All do, as they must, take into account the local and regional diversity of this country.

In recommending these special services for children, the committee concluded that the EMS-C must not be separate from, but instead should be an integrated part of, the entire emergency medical system. At the same time, the committee recognized how very important it will be to make sure that the needs of children will not be lost again in the continuing development of that larger emergency medical system. To ensure that, the committee has recommended the creation of specific agencies and defined specific roles for them in both state and federal governments. These public agencies must be effectively linked with the private sector.

The committee recognized the extremely important role that effective rehabilitation services can and must play in this matter. Nonetheless, just as it was not the committee's charge to design the ideal medical home for children, it was not the committee's charge to design rehabilitation services. Instead this was addressed by stressing the need for extremely effective linkages between EMS-C and rehabilitation.

Thus, throughout its deliberations, the committee recognized the very great importance of establishing effective communication systems and of developing an information system that could obtain data to be used to assess the effectiveness of the system (and improve it continually) and to provide information useful in developing the means to prevent emergencies. If there were but one thing that this author would stress, it would be that.

In this time of national economic duress, the committee was cognizant that the matter of costs and benefits would be raised. Obtaining accurate and comprehensive data on the cost or the benefits of emergency medical systems is extremely difficult. The direct and immediate health care costs of nonfatal injuries in children are estimated to be in excess of \$5 billion a year, and the indirect costs, including the loss of productive life, greatly exceed those direct costs of caring for injured children. Available estimates indicate that the implementation of comprehensive and effectively linked services for emergency medical care does ensure better outcomes and that the economic benefits of an emergency medical system for children would be very large. Therefore, the committee believes that the cost of developing an effective EMS-C would be well worth it.

The committee is aware that great thought, effort, and time will be required to develop the EMS-C that our children need and deserve. These efforts can build on the accomplishments of many groups during the past quarter-century since the landmark NRC report *Accidental Death and Disability: The Neglected Disease of Modern Society*. The committee believes that this is an opportune time to develop EMS-C since the country seems to be on the threshold of significant health care reform. Therefore, we hope this report will stimulate increased attention to and development of these urgently needed emergency medical services in the context of an effective system of primary care for children.

In closing, I wish to express my great appreciation and admiration to the committee and to the IOM staff for their commitment, energy, and expertise, all of which were provided ceaselessly and patiently and, most important, very productively. I have not listed them here because they are listed elsewhere, but that must not detract from the debt I owe or the admiration I have for them.

Donald N. Medearis, Jr., M.D.  
Chair



## Acknowledgments

The Committee on Pediatric Emergency Medical Services would like to acknowledge the assistance that they and the study staff received from several individuals and groups during this study.

The study conducted by this committee was funded by the Maternal and Child Health Bureau (MCHB) of the Health Resources and Services Administration (HRSA) through the Emergency Medical Services for Children (EMS-C) Demonstration Grant Program. MCHB staff members—David Heppel, M.D., Director of the Division of Maternal, Infant, Child, and Adolescent Health; Peter Conway, the study's project officer; and Jean Athey, Ph.D., Director of the EMS-C and Injury Prevention Programs—helped keep the committee and staff informed of relevant activities and provided access to useful background material on the demonstration grant awards. Also generous with their assistance were members of the staff of the Emergency Medical Services Division of the National Highway Traffic Safety Administration at the Department of Transportation: Susan Ryan, M.S., chief of the division, and Highway Safety Specialists Gary Criddle, R.N., Thomas Dolan, and Charles Glass.

The committee benefited from presentations by guests invited to two meetings. In December 1991, the committee was joined by Paul Anderson, Chief of the Idaho Emergency Medical Services Bureau, Wade Spruill, Jr., Director of Emergency Medical Services for Mississippi, and Javier Gonzalez del Rey, M.D., from the staff of the Shenandoah Community Clinic in Martinsburg, West Virginia, to discuss emergency medical care in nonmetropolitan and rural areas. In March 1992, George Foltin, M.D., Director of Pediatric Emergency Medical Services, Bellevue Hospital Center, New York City, spoke with the committee on behalf of the National Association of Emergency Medical Services Physicians regarding medical control of prehospital

care. Laurie Flaherty, R.N., chair of the pediatric committee of the California chapter of the Emergency Nurses Association, addressed nursing issues for the committee.

Members of the committee and staff were able to attend conferences in June 1991 and February 1992 that were held as part of the EMS-C demonstration grant program. The conferences gave the committee members opportunity to meet grantees from some 30 EMS-C projects, to learn about their activities and experiences, and to gain insight into the issues in the field. The two EMS-C resource centers have been especially helpful to the study staff; in particular, the committee thanks Jane Ball, R.N., Dr.P.H., and Bryna Helfer of the EMS-C National Resource Center in Washington, D.C., and Deborah Henderson, R.N., M.A., of the National EMS-C Resource Alliance in Torrance, California.

The committee appreciates the willingness of individuals from a variety of organizations to speak with members of the study staff and to provide background materials: Albert N. Brasile, Centers for Disease Control and Prevention; Donald C. Bross, J.D., Ph.D., C. Henry Kempe National Center for the Prevention and Treatment of Child Abuse and Neglect; Douglas Brown, EMS Data Systems, Inc.; Ceil M. Hendrickson, R.N., Children's National Medical Center; Ronald Kropf, M.H.S., Maryland Institute of Emergency Medical Services Systems; David Lloyd, National Center for Child Abuse and Neglect; Susan Mackenzie, Ph.D., Health and Welfare Canada, Laboratory Center for Disease Control; Stephen Mawn, American Society for Testing and Materials; Meri McCoy-Thompson, M.A.L.D., National Center for Education in Maternal and Child Health; Greg McDonald, Arrowhead (Minnesota) EMS System; Mary McDonald, R.N., M.S.P., National Heart, Lung, and Blood Institute; Deborah Nadzam, Ph.D., R.R.T., Joint Commission on Accreditation of Healthcare Organizations; Mary Overpeck, National Institute of Child Health and Human Development; I. Barry Pless, M.D., Montreal Children's Hospital; and William E. Stanton, National Emergency Number Association.

The committee also received helpful contributions from Joanne Lukomnik, M.D., a consultant to the committee. Jennifer McGrady, a student intern at the Institute of Medicine (IOM), helped prepare for the first committee meeting and began the task of assembling background materials. Gail Pearson, a free-lance writer, produced the earliest draft of some of the material for the report. The report has benefited from the useful (anonymous) critiques received as a result of the formal review that must be conducted before the release of any IOM report.

Finally, the committee expresses its considerable appreciation to members of the IOM staff whose efforts have ensured the successful completion of the study and this report. Donna Thompson, Administrative Assistant, provided essential secretarial support. Other members of the IOM staff

contributing to this project include Holly Dawkins, Research Assistant; Jo Harris-Wehling, Program Officer; and Nina Spruill, Financial Associate. The study began under the direction of Michael Millman, who did much to assist the committee in organizing its approach to the study and in formulating the recommendations reflected in the report. Finally, throughout the study, Karl Yordy, Director of the Division of Health Care Services, provided invaluable guidance and support.



# Contents

SUMMARY	1
1 INTRODUCTION	26
The Issue: Ensuring Emergency Medical Care for Children Who Need It, 27	
The Institute of Medicine Study, 28	
A Vision of the Ideal System: Establishing Critical Linkages, 30	
Guiding Principles, 33	
Organization of the Report, 34	
Audience for This Report, 36	
The Committee's Goal, 36	
Note, 37	
2 RISKING OUR CHILDREN'S HEALTH: A NEED FOR EMERGENCY CARE	38
Definitions, 39	
Why Children Need Special Attention, 41	
Epidemiology of Childhood Emergencies, 45	
Costs of Injury and Illness, 61	
Summary, 63	
Notes, 64	
3 EMERGENCY MEDICAL SERVICES SYSTEMS: ORIGINS AND OPERATIONS	66
Development of EMS and EMS Systems, 67	
Providing Emergency Medical Services, 83	
Structure of EMS Systems, 85	

Summary, 97	
Notes, 98	
Appendix 3A, 100	
Appendix 3B, 103	
<b>4 LEARNING HOW TO PROVIDE GOOD CARE: EDUCATION AND TRAINING</b>	10
Education and Training for the Public, 108	
Education and Training for Health Care Professionals, 118	
Other Concerns, 138	
Summary, 145	
Notes, 147	
<b>5 BEING READY TO DELIVER GOOD CARE: PUTTING ESSENTIAL TOOLS IN PLACE</b>	14
Definitions, 149	
Equipment, 150	
Protocols, 156	
Medical Control, 167	
Categorization and Regionalization, 170	
Summary, 183	
Notes, 185	
<b>6 CONNECTING THE PIECES: COMMUNICATION</b>	18
Public Access to the Emergency Care System, 188	
Prehospital Communication, 200	
Communication in Hospital Care, 205	
Follow-up: Enhancing Continuity of Care, 211	
Feedback, 216	
Other Important Forms of Communication, 217	
Summary, 221	
Notes, 222	
<b>7 KNOWING WHAT IS HAPPENING AND WHAT IS NEEDED: PLANNING, EVALUATION, AND RESEARCH</b>	22
Understanding the Information Gap, 225	
Planning, Evaluation, and Research, 227	
Understanding Current and Emerging Sources of Data and Data Systems, 230	
Improving Information Resources, 246	
Implementing a Research Agenda, 252	
Summary, 259	

Notes, 261	
Appendix 7A, 265	
Appendix 7B, 274	
<b>8 LEADERSHIP FOR DEVELOPING EMERGENCY MEDICAL SERVICES FOR CHILDREN</b>	<b>280</b>
The Disjointed "System" of Today, 281	
A Focus for Emergency Medical Services for Children, 283	
A Federal Center for Emergency Medical Services for Children, 284	
State Agencies and Advisory Councils on Emergency Medical Services for Children, 298	
The Case for New Entities to Address Emergency Medical Services for Children, 310	
Financing Centers, Agencies, and Related Activities, 313	
Summary, 316	
Notes, 317	
<b>9 IMPROVING EMERGENCY MEDICAL SERVICES FOR CHILDREN: LOOKING TO THE FUTURE</b>	<b>321</b>
Benefits and Costs, 321	
A Changing Health Care Environment, 325	
Final Thoughts, 334	
Notes, 334	
<b>REFERENCES</b>	<b>336</b>
<b>APPENDIXES</b>	<b>367</b>
A Acronyms, 369	
B Biographies of Committee Members, 373	
<b>INDEX</b>	<b>379</b>

## TABLES

2-1 Deaths from Injury Among Children and Adolescents Ages 0 to 19, by Cause, Age, and Sex, 1988	48
2-2 Deaths from Specified Categories of Illness Among Children and Adolescents Ages 0 to 19, by Cause, Age, and Sex, 1988	52
2-3 Hospitalizations for Injury and Specified Categories of Illness Among Children and Adolescents Less than 15 Years Old, by Cause, 1990	54

3-1	Essential Components of Emergency Medical Services Systems, as Specified by the Emergency Medical Services Systems Act of 1973 (P.L. 93-154)	72
3B-1	Projects Funded by the EMS-C Demonstration Grant Program, 1986-1992	104
6-1	Percentage of Population Covered by a 9-1-1 System, by State	190
7-1	Priority Data Elements for a National Uniform Data Set for Emergency Medical Services for Children: Prehospital Services and Emergency Departments	249
7-2	Summary of High-Priority Topics for a Research Agenda in Emergency Medical Services for Children	255
7B-1	Data Elements Considered for a National Uniform Data Set for Emergency Medical Services for Children: Prehospital Services and Emergency Departments	276

EMERGENCY MEDICAL SERVICES  
for  
CHILDREN



## Summary

Emergency care for children's serious illnesses and injuries is a part of the health care system that parents hope never to need. Unfortunately, many families will need such care for their children, and they will want the best care possible. Life-threatening emergencies arise in many forms—motor vehicle crashes, drownings, poisonings, burns, pneumonia, meningitis, and asthma only begin a long list. Each year, injury alone claims more lives of children between the ages of 1 and 19 than do all forms of illness. Most admissions to pediatric intensive care units, however, are due to acute illness. Overall, some 21,000 children and young people under the age of 20 died from injuries in 1988. Nearly 21,000 more deaths occurred because of illness and other disorders (excluding congenital anomalies and birth-related conditions). Thousands more children were hospitalized and millions more were treated in emergency departments (EDs).

Clearly, preventing emergencies is the best "cure" and must be a high priority, but as yet, prevention is far from foolproof. When prevention fails, families should have access to timely care by trained personnel within a well-organized emergency medical services (EMS) system. Services should encompass prevention, prehospital care and transport, ED and inpatient care at local hospitals and specialty centers, and assistance in gaining access to appropriate follow-up care including rehabilitation services.

For too many children and their families, however, these resources have not been available when they were needed. Although EMS systems and hospital EDs are widely assumed to be equally capable of caring for children and adults, this is not true. In many EMS systems, children's needs

have been overlooked as services developed for adult trauma and cardiac patients. Progress has been made in recent years to improve emergency care for children, but much work remains to be done. This report identifies essential steps to be taken to make available to children the high quality emergency care they need and deserve.

## **RECOGNIZING A NEED FOR EMERGENCY MEDICAL SERVICES FOR CHILDREN**

### **Origins of the Study and Report**

In 1984, Congress approved a demonstration grant program to expand access to and improve the quality of emergency medical services for children (EMS-C) available through existing EMS systems and to generate knowledge and experience that other states and localities could draw on in their efforts to enhance EMS-C capabilities. This ongoing program is operated by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (DHHS).

In response to continuing congressional interest, HRSA requested that the Institute of Medicine (IOM) undertake a study of pediatric emergency medical services to look at the issues more broadly than individual demonstration projects could. The IOM study was guided by a 19-member committee with expertise in pediatrics, emergency medicine, trauma, nursing, prehospital emergency services, injury prevention, hospital administration, public policy, and local government (see roster), and it benefited from the contributions of others who met with the committee.

The committee's report examines the nature and extent of acute illness and injury among children, reviews the origins and organization of EMS systems, describes the current state of effective care, addresses data and standards needed for surveillance and evaluation of services and outcomes, and recommends policy mechanisms to promote development of better systems of care. The committee took into account system components needed to reduce the negative consequences of pediatric emergencies, the full spectrum of facilities involved in pediatric emergencies, particular problems and capabilities of urban and rural settings, and experience gained from the demonstration projects.

The report is addressed to a wide audience: health policymakers; health professionals, including physicians in pediatrics, family practice, surgery, and emergency medicine, nurses in emergency, critical care, and pediatric settings, and prehospital care providers at all levels; hospital administrators; members of voluntary organizations concerned with public safety; parents and the concerned public; and the officials responsible for organizing and operating EMS systems at the national, state, and local levels.

### A Vision of Emergency Medical Services for Children

Public policies and programs for children are often fragmented, with special initiatives devised *ad hoc* or *de novo* to meet special needs. The committee finds this unacceptable for EMS-C. It adopted a broad vision of an ideal EMS-C system as part of overall EMS and as part of a comprehensive and coherent approach to children's health care (which should include a "medical home" for routine care). The connections between primary care, emergency care, tertiary (i.e., specialty) care, and rehabilitation should be as seamless as possible.

EMS-C systems must be prepared to care for *all* children: regardless of age (infants, toddlers, schoolchildren, or adolescents); condition (ill, injured, or with special health care needs); or economic resources (insured, uninsured, or in a public assistance program). The committee also emphasizes that EMS systems should view ensuring high quality emergency care for children as a further step in the same process that has led them to develop increasingly sophisticated care for adults.

The committee concluded that, if children's needs in emergency care are to be met, EMS-C must establish three important linkages. First, the separate components of EMS-C must be connected to form a system. Second, EMS-C must be integrated into the larger EMS system. Third, EMS-C must develop strong ties to the broader elements of child health care. Two approaches are needed to fashion these linkages. First, a "top down" approach—reflected in recommendations for federal and state action—is essential to ensure that the needs of all children are addressed in a comprehensive, efficient, and equitable manner. Second, a "bottom up" approach, which depends on the efforts of concerned and committed individuals and communities, is a vital element in making sure that EMS-C is recognized as a priority and receives the attention it requires at the local level. The committee's examination of EMS-C issues proceeds from the position that both approaches are essential.

### Children and Why They Need Special Attention

Because no consensus exists regarding the age at which childhood ends and adulthood begins, the committee declined to fix a specific age range to define the "children" to be served by EMS-C. Instead, the committee emphasizes its concern for the entire span of childhood: infants, toddlers and preschoolers, schoolchildren, and adolescents. The one exclusion deemed appropriate for this report is newborns and the intensive care that they may require immediately after birth.

Care for seriously ill and injured children cannot presume that they are simply "little adults." It can, in fact, be more difficult to assess the severity

of illness or injury in children than in adults. Important anatomic, physiologic, and developmental differences exist between children and adults. Children are smaller and proportioned differently; normal respiratory rates, heart rates, and blood pressure differ; characteristic changes in vital signs that signal deterioration in adults may not occur in children; and stages of children's physiologic, emotional, and behavioral development affect their responses to medical care and their risk of injury and illness.

### Epidemiological Considerations

Limited data make it difficult to determine in detail how many children need emergency care, the kinds of illness and injury they experience, and the nature and outcome of the care they receive. What is clear is that injury is the leading cause of death among children over the age of 1 year. Overall, injuries associated with motor vehicles account for the largest number of deaths. Drowning, burns, and fire-related injuries are significant contributors to deaths, especially among younger children. Among adolescents, many deaths are due to homicide and suicide. In anatomic terms, brain injuries (caused directly by trauma or as a secondary result of illness or other injury) contribute to many deaths and long-term impairments for survivors.

Fewer children die from acute illnesses than from injuries, but many more are hospitalized. In 1990, for example, children experienced about 266,000 hospitalizations principally for injury and 701,000 for respiratory conditions (which represents nearly a third of all hospitalizations among children less than 15 years old). Respiratory, circulatory, or neurological crises, which can have a variety of causes, characterize many illness-related emergencies. With no commonly accepted set of diagnoses defining illness-related emergencies, however, determining specific numbers of cases from available mortality and hospitalization data is difficult. Some deaths attributed to sudden infant death syndrome, the second leading cause of death among infants, may be due to child abuse or inadvertent suffocation.

Children with chronic illnesses or other special health care needs are especially vulnerable to serious injury and illness. They are likely to need specialized emergency care, to need care more frequently than other children, and to need care for complaints that would be less serious in functionally healthy children.

Several other factors are also of special concern. Adolescent girls may require emergency care for pregnancy-related problems, including premature labor. Children experiencing psychiatric or behavioral emergencies require care from mental health professionals as well as from medical and surgical providers. Violence, in the form of homicide, suicide, assault, and child abuse, is a special threat to children's physical and emotional well-being.

risingly, firearms are used in homicide and suicide among chil-

ED visits and prehospital care, for injury or illness, are espe-  
Estimates are that children account for 25 to 35 percent of all  
about 30 million in 1990) and appear to make up about 10  
patients receiving prehospital services. The most seriously ill  
children may require care in pediatric specialty centers and  
abilitation services.

on EMS-C are being increased by factors other than simply  
✓ of illness and injury among children: inadequate access to  
imary care; increased survival and home care of children who  
illnesses or are technology-dependent; and staff, facility, and  
e limitations. Office-based physicians encounter children re-  
gency care, but many offices may not be adequately prepared  
e immediate treatment that those children need.

costs associated with injury have been estimated at \$13.8 bil-  
laren under age 15 and \$39.1 billion for 15- to 24-year-olds.  
re of the few major illnesses for which costs have been esti-  
al direct and indirect costs for children under age 18, excluding  
mounted to \$1.3 billion. Both injury and illness carry nonmonetary  
and distress for children and their families.

### Key Historical Developments

elopments in the mid-1960s brought EMS to the attention of  
, and local governments and the medical community. First, the  
*Report Accidental Death and Disability: The Neglected Disease*  
*Society*, published in 1966, highlighted the need for better trauma  
1, work by physicians in Ireland demonstrated that rapid treat-  
iax emergencies could improve survival. Trauma and emer-  
care continue to be significant priorities for EMS systems.

funding was first made available to support development of  
s through the National Highway Traffic Safety Administration  
ment of Transportation and through the Department of Health,  
nd Welfare (now DHHS) under the 1973 Emergency Medical  
ems (EMSS) Act. A grant program underwritten by the Robert  
on Foundation provided further resources at this important de-  
stage. The DHHS role decreased in 1981 when EMS funding  
nto a block grant program that allowed states to decide how to  
nds among seven preventive health and health services pro-  
was allocated substantially less support, but over time, many  
cialities increased their own funding for EMS.

es for emergency care were developing within the health care

community, including training programs for physicians, nurses, and prehospital providers (i.e., emergency medical technicians [EMTs] and paramedics) and specialized trauma units. During the 1970s, however, pediatricians and pediatric surgeons recognized that children's emergency care needs were not receiving adequate attention. To correct this oversight, they began working with hospitals, EMS agencies, their colleagues, and their communities to improve the ability of EMS systems to care for children.

Early successes such as creation of a regional pediatric trauma center as part of Maryland's statewide EMS system and the Los Angeles program to identify EDs qualifying as "emergency departments approved for pediatrics" or "pediatric critical care centers" have served as models for similar efforts elsewhere. Training in pediatric emergency care became available through locally developed programs and nationally recognized courses (e.g., Pediatric Emergency Medical Services Training Program, Pediatric Advanced Life Support [PALS], and Advanced Pediatric Life Support [APLS]).

Awareness of EMS-C issues increased with the start of the EMS-C demonstration grant program in HRSA. Since it began, the program has supported 20 demonstration projects, 11 implementation programs, and 5 special projects. Grantees have created a variety of products including training materials, treatment protocols, and system guidelines. Two EMS-C resource centers have also been established to assist grantees and others interested in emergency care for children.

### **PRIORITY ISSUES IN IMPROVING EMERGENCY MEDICAL SERVICES FOR CHILDREN**

The EMSS Act did much to shape the development of EMS systems by specifying 15 essential functions, including training, communications, transportation, critical care facilities, and standard record keeping. For EMS-C, this committee sees seven essential areas of system responsibility: identifying emergencies; ensuring access to the services of the system (e.g., through 9-1-1 telephone service) with dispatch of equipment and personnel; providing appropriate prehospital care; transporting patients; providing definitive medical care; communicating among emergency care providers and with others, including parents and primary care providers; and using information systems and feedback to assess and improve patient care, to enhance system performance, and to identify injury prevention needs.

Achieving these goals involves medical and administrative considerations and requires the participation and cooperation of a variety of individuals and institutions. No one agency or institution has authority over all the elements involved. Thus, efforts to address the EMS needs of *children* must consider all the elements that constitute EMS systems, understand the specific channels through which change can be implemented, and make

## **Education and Training**

Because many aspects of emergency care are different for children than for adults, health care professionals and others with responsibility for children must have the specific knowledge, understanding, and skills necessary to provide appropriate care. The committee's review of desirable elements of such educational efforts led to seven formal recommendations, which promote its view that better education and training are essential for achieving larger goals for EMS-C.

### *Programs for the Public*

Parents, as well as others with routine responsibility for the well-being of children (e.g., teachers, school nurses, day-care providers, coaches, life-guards and other camp and recreation personnel, and scouting and other youth group leaders), play a vital role in three areas: preventing illness and injury, recognizing (when prevention has failed) that urgent medical care is needed, and gaining access to such care. Evidence suggests that parents are not always aware of the greatest risks to their children, and they can, therefore, be poorly prepared to prevent them. Parents and the public must also understand when and how to use the EMS system. Needed emergency care may be delayed if the seriousness of a child's condition is not recognized. In other cases, unnecessary use of EMS resources can impair the system's ability to provide care for true emergencies. Public information and education programs on EMS-C should ultimately reach the entire population, including children themselves, but they should be aimed first at parents and adults who are involved most directly in the care, education, and oversight of children.

The committee concluded that public education efforts should focus on three areas: prevention and safety; basic first aid and cardiopulmonary resuscitation (CPR); and when and how to use the EMS system. Programs should include a core of universally appropriate material plus issues of specifically local concern. Guidance in using the EMS system, for example, must always take into account specific local mechanisms for requesting assistance, and prevention messages should target particular risks for illness and injury that children in that community face.

Opportunities for training include health care visits, schools, day care, recreation, and community programs. A child's primary care provider should

play an important role in ongoing education of parents. Public education programs need to be a continuing activity rather than a special project and must be reviewed periodically to ensure that their content is consistent with current medical practice guidelines.

To address these issues, the committee recommends that:

- states and localities develop and sustain programs to provide to the general public of all ages adequate and age-appropriate levels of education and training in safety and prevention, in first aid and cardiopulmonary resuscitation, and in when and how to use the emergency medical services system appropriately for children. It recommends further that:
  - the content of such programs reflect the particular needs of each community;
  - the content of such programs reflect the special medical, developmental, and social needs of children;
  - parents and other adults who are responsible for the care and education of children (e.g., day-care workers, teachers, coaches) receive highest priority in such programs; and
  - adolescents also be a high priority in this endeavor.
- states and localities develop and maintain specific guidelines or criteria to ensure basic consistency and quality of educational programs across communities and populations reached, including specific content elements that those education programs should cover.

#### *Programs for Health Care Professionals*

Until very recently, curricula in emergency care have included little pediatric content and pediatrics curricula have given little attention to emergency care. The committee endorses efforts to incorporate essential elements of pediatric emergency care into the initial and continuing training of all health care providers who care for children. Some material should be included in training programs for all providers; other training needs are specific to particular kinds of providers.

General education and training needs include recognizing characteristic signs of serious illness or injury in children of all ages, rendering essential care for all pediatric patients, and addressing psychosocial aspects of pediatric emergency care. Underlying these should be adequate training in pediatric anatomy, physiology, and pathophysiology. In addition to clinical training, emergency care providers must learn about the organization and operation of EMS systems, particularly local and regional services, and about the importance of data collection and analysis.

Ensuring adequate training for all practitioners will require attention to initial qualifying training for prehospital providers, to beginning years of education for other health professionals, to graduate and residency training programs for nurses and physicians, and to continuing education courses. The committee specifically recommends that:

- organizations that accredit training programs for prehospital care providers require that the curricula for EMT-Basic, EMT-Intermediate, and EMT-Paramedic provide training in pediatric basic life support; in the medical, developmental, and social needs of all children; and in caring for children with special health care needs.
- accreditation organizations require that curricula for EMT-Paramedic programs include training in advanced life support for children.
- appropriate accrediting organizations require that the primary curricula for all health care professionals include training in basic resuscitation skills and the use of the emergency medical services system. These curricula must give specific attention to the unique medical, developmental, and social needs of children.
- appropriate accrediting organizations ensure that graduate nursing programs in emergency, pediatric, and family practice nursing include training in emergency care for children, including advanced resuscitation.
- the Accreditation Council for Graduate Medical Education ensure that residency programs for emergency medicine, family medicine, pediatrics, and surgery include training in emergency care for children, including advanced resuscitation.

Continuing education courses (e.g., PALS, APLS) are currently a major source of training in pediatric emergency care for existing practitioners. Although such courses are not sufficient by themselves as a long-term approach to providing needed training, they are an essential component of an overall program of EMS-C training. Because most providers will have limited opportunities to apply their knowledge and skills, they need training resources that will enable them to refresh their skills and to learn about current practice guidelines.

All parties involved with EMS-C should address certain other education and training issues as well. These include making appropriate training available and affordable, particularly to volunteers and to providers in rural areas; evaluating education and training efforts with special attention to the problem of poor retention of CPR and other skills (by members of the public and by health care providers); establishing a central source of information on EMS-C education and training materials; and financing education and training.

### **Putting Essential Tools in Place**

Emergency care providers must have system resources available that enable them to use their training and skills successfully. Despite impressive progress in recent years, EMS systems must improve their ability to meet the needs of pediatric patients in five major areas. Equipment and supplies (including medications) necessary for treating children are often unavailable. Protocols—standardized sets of procedures or decision algorithms that are developed to guide patient care—have not been developed for pediatric emergency care. Medical control, which entails physician oversight of care provided by prehospital personnel and input into broader planning efforts, lacks sufficient pediatric expertise. Categorization of the pediatric emergency care capabilities of hospitals and other facilities has not been extensive enough. Finally, regionalization of care—deliberate efforts to establish relationships between a specialty center and the communities and community hospitals in a natural (geographic) referral area—has been stymied in many areas by administrative, economic, and political obstacles.

More investment in supplies and equipment appropriate for children (across the entire pediatric age range) would be a significant and cost-effective improvement in the capacity of EMS systems to discharge their responsibilities to children, in part because the marginal cost (to EMS systems) of having durable and disposable materials and supplies suitable for pediatric cases is quite low. The committee calls for each health care provider or agency to define the emergencies that occur in the patient populations that they serve and to ensure that the necessary and proper equipment is available to treat critically ill and injured neonates, infants, children, and adolescents. To this end, **the committee recommends that all state regulatory agencies with jurisdiction over hospitals and emergency medical services systems require that hospital emergency departments and emergency response and transport vehicles have available and maintain equipment and supplies appropriate for the emergency care of children.** The objectives are to ensure that all hospital EDs and EMS systems maintain at least a minimal level of essential equipment and that consistency in these requirements is appropriately balanced with the flexibility needed in special circumstances. If these materials are used infrequently, they must be monitored on a regular basis so that they do not deteriorate or become outmoded.

Protocols have a role to play in every phase of the EMS system. They help direct decisions about when and where care should be given as well as guide what care is rendered and how. Each phase of care needs specific kinds of guidance. Protocols have a solid place already in many areas of health care, including EMS for adults. What is required now is more systematic development, dissemination, application, and evaluation of guide-

lines and protocols with tested pediatric elements and components for the full range of EMS-C activities—dispatch, prehospital care, transport, ED services, hospital inpatient care, and emergency care in outpatient settings.

Medical control operates in two ways. *On-line* medical control implies real-time direction by designated medical personnel of prehospital care for seriously injured or ill children; services may include authorization for advanced life support procedures, triage and destination assignment, and management of patients who refuse care. *Off-line* medical control operates through policymaking activities, training programs, quality assurance efforts, and the like. In comparison with on-line medical control, these efforts are likely to be broader in scope and setting and to relate more to the long-term development of guidelines and protocols. Both on-line and off-line medical control require active participation, leadership, and commitment from health care professionals (particularly physicians) with experience and training in caring for infants, children, and adolescents.

Categorization of institutions and regionalization of services, often associated conceptually and practically, demand stronger involvement and investment than has been true heretofore. Categorization is an effort to identify the readiness and capability of a health care facility (usually a hospital) and its staff to provide optimal emergency care. Once criteria for classifying capabilities are available, implementation mechanisms can range from entirely voluntary to government designation. Regionalization (e.g., of ground and air transport systems, intensive care units, trauma centers, or burn centers) is often a more formal effort by outside agencies to specify particular centers or institutions that can offer complex, sophisticated services in a particular geographic area. It also can involve initiatives to develop formal arrangements between those facilities and less specialized ones regarding patient referral so as to promote optimal allocation of health care resources. Such arrangements may need to span state boundaries to bring services to those states, or parts of states, that lack specialty centers of their own.

If categorization and regionalization are pursued collaboratively, they can make EMS-C, as part of larger EMS systems, both more efficient and more effective. The range of interested parties—professional groups, individual practitioners and institutional providers, public and patient advocacy groups, local and state governments—creates special complexities. To improve chances for accurately categorizing facilities and designating regional referral centers for pediatric care, the committee generally prefers “local” as contrasted with “national” decisionmaking and solutions. Nevertheless, it sees some need for guidance at the national and state level to foster appropriate identification and classification of referral centers and to overcome difficult inter- and intrastate questions of legal and regulatory matters, transfer policies, and reimbursement. Specifically, **the committee recommends that all state regulatory agencies with jurisdiction over hospitals and EMS**

systems address the issues of categorization and regionalization in overseeing the development of EMS-C and its integration into state and regional EMS systems.

## Communication

Communication is a critical, but complex, element in the successful operation of *systems* of emergency medical care. Context plays a strong role: actually delivering services to specific individuals raises communication issues different from those related to planning and exchanging information independent of patient care. Special questions about technology and equipment must be addressed. Participants in the communication process are obviously important factors, because patients and their families (or other bystanders), providers, and administrators all interact in various combinations and for various purposes, often under stressful circumstances. Better communication among all the providers who care for a patient calls for particular attention to follow-up on patient outcomes and further care and for feedback from other providers.

### *Public Access to Emergency Services*

Easy public access to the EMS system is essential and can be facilitated with a universal emergency access number—9-1-1 and enhanced 9-1-1 (E9-1-1) emergency response systems. The latter typically draw on computerized databases to identify automatically the telephone number and location of the caller; this, in turn, means that the EMS system can route calls to appropriate jurisdictions and send assistance even if callers cannot communicate effectively because of their condition, language barriers, or other reasons. All these factors mean that response times can be reduced, with presumably more effective intervention and, ultimately, improved patient outcomes.

Movement toward universal adoption of 9-1-1 or E9-1-1 systems is regarded as so significant that the committee recommends that all states ensure that 9-1-1 systems are implemented. The 9-1-1 system must be universally accessible and effectively linked to the emergency medical services system. Communities with 9-1-1 systems in place should move toward enhanced 9-1-1 capabilities. Communities with no 9-1-1 system should move directly to an enhanced 9-1-1 system.

### *Communication Within EMS Systems*

Sometimes, communication takes the form of obtaining accurate and timely advice rather than summoning an EMS response. Poison control

centers, especially those certified by the American Association of Poison Control Centers, can give the public and emergency care providers specialized guidance via telephone for managing the care of children exposed to potentially toxic materials. Parents also seek telephone advice from hospital EDs. This service can yield benefits, especially if given by well-trained staff with adequate guidance, but it also poses risks because no direct assessment of a child's condition can be made. The committee strongly advocates appropriate training, clear protocols, careful documentation, and routine monitoring in ED programs offering telephone advice.

Communication is a key component in prehospital services, using technologies that range from quite commonplace to rather sophisticated (e.g., standard telephone links, radio systems, microwave networks, and satellite links). On-line medical control requires good communications systems to link prehospital personnel with designated medical personnel (e.g., at a base hospital, which can be quite distant). When EMS systems develop on-line medical control, they must consider factors such as the availability and cost of base-hospital staff, the level of care that prehospital providers are authorized to deliver, and the perceived need for direct medical oversight of prehospital care. In rural areas, where ED personnel and expertise in emergency medicine are limited, on-line medical direction may depend on communications systems that permit contact with more distant hospitals.

Good communication in hospital care is also crucial. ED personnel consult with "local" experts and a child's primary care physician, as well as with regional and national experts through poison control centers, pediatric referral centers, and telephone hot lines. Facsimile communication can be a valuable adjunct for long-distance and local consultation. When children must be transferred to referral centers, clear communication between hospitals and health care providers involved is essential to ensure that vital clinical and administrative information is exchanged. Here the committee believes that written transfer agreements between hospitals speed the transfer process by settling many procedural and administrative matters in advance. Development of centralized communication services also may ease transfer arrangements and help make efficient use of regional resources.

Communication plays an important role in ensuring that an ill or injured child obtains the full range of services, from prevention to acute care and on to rehabilitation, that comprise EMS-C. The committee thus argues that EMS-C systems must give special attention to follow-up in three areas: primary care, post-ED care, and rehabilitation. In addition, more and better feedback regarding patient care and system performance is needed throughout EMS and EMS-C systems; it promotes optimal patient care and effective linkages between system components. Feedback needs to reach individual providers as well as managers and administrators and may require systematic data collection.